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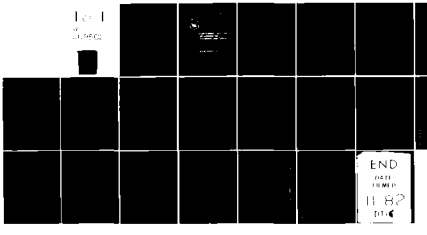

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Basic design suidance for maintenance facilities for ammunition, explosives and toxics covered by Category Group 216 is presented for use by experienced architects and engineers. The contents include design data for buildings and shop areas to provide facilities for repairing and maintaining ammunition, rockets, bombs, mines, grenades, torpedoes, depth charges, air/underwater weapons, demolition materials, pyrotechnics, guided missile fuels, ammunition parts, and related chemicals.

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NAVFAC DM-28.3
NOVEMBER 1981

MAINTENANCE FACILITIES FOR AMMUNITION, EXPLOSIVES, AND TOXICS

DESIGN MANUAL 28.3

APPROVED FOR PUBLIC RELEASE

DEPARTMENT OF THE NAVY
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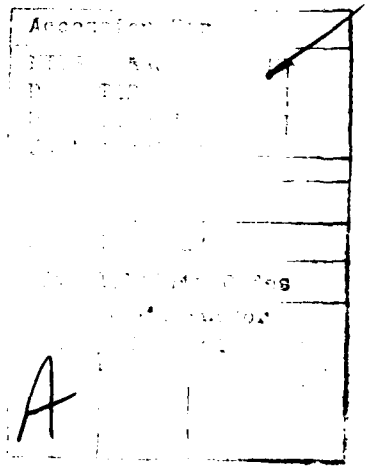
ABSTRACT

Basic design guidance for maintenance facilities for ammunition, exposives and toxics covered by Category Group 216 is presented for use by experienced architects and engineers. The contents include design data for buildings and shop areas to provide facilities for repairing and maintaining ammunition, rockets, bombs, mines, grenades, torpedoes, depth charges, air/underwater weapons, demolition materials, pyrotechnics, guided missile fuels, ammunition parts, and related chemicals.



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FOREWORD

This design manual is one of a series developed from an evaluation of facilities in the shore establishment, from surveys of the availability of new materials and construction methods, and from selection of the best design practices of the Naval Facilities Engineering Command, other Government agencies, and the private sector. This manual uses to the maximum extent feasible, national professional society, association, and institute standards in accordance with NAVFACENGCOM policy. Deviations from these criteria should not be made without prior approval of NAVFACENGCOM Headquarters (Code 04).

Design cannot remain static any more than can the naval functions it serves or the technologies it uses. Accordingly, recommendations for improvement are encouraged from within the Navy and from the private sector and should be furnished to NAVFACENGCOM Headquarters (Code 04). As the design manuals are revised, they are being restructured. A chapter or a combination of chapters will be issued as a separate design manual for ready reference to specific criteria.

This publication is certified as an official publication of the Naval Facilities Engineering Command and has been reviewed and approved in accordance with SECNAVINST 5600.16.

W. M. Zobel
Rear Admiral, CEC, U. S. Navy
Commander
Naval Facilities Engineering Command

MAINTENANCE FACILITIES DESIGN MANUALS

DM NO.	Superseded Chapters in Basic DM-28	TITLE
28.1	1	Aircraft Maintenance Facilities
28.2	2 & 5	Shipyard Maintenance Facilities
28.3	3	Maintenance Facilities for Ammunition, Explosives, and Toxics
28.4	4	General Maintenance Facilities
28.5	6	Environmental Control - Design of Clean Rooms
28.6	-	Aircraft Fixed Point Utility Systems

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MAINTENANCE FACILITIES FOR AMMUNITION, EXPLOSIVES, AND TOXICS

CONTENTS (continued)

CONTENTS (continued)

MAINTENANCE FACILITIES FOR AMMUNITION, EXPLOSIVES, AND TOXICS

Section 1. INTRODUCTION

1. SCOPE. This manual presents criteria for ammunition, explosives, and toxics maintenance facilities at naval shore activities. Special requirements for the individual project must be obtained from Naval Facilities Engineering Command Headquarters (NAVFAC HQ) and/or the cognizant management command or bureau.

2. CANCELLATION. This manual on maintenance facilities for ammunition, explosives, and toxics, NAVFAC DM-28.3, cancels and supersedes Chapter 3, NAVFAC DM-28, Maintenance Facilities of December 1974, Change 1 of January 1975 and Change 2 of October 1975, and Change 3 of June 1976.

3. RELATED CRITERIA.

a. Definitive Drawings. Definitive drawings, where they exist for maintenance facilities covered by this manual, are contained in Definitive Designs for Naval Shore Facilities, NAVFAC P-272 and are an integral part of the Naval Facilities Engineering Command's (NAVFAC) design program.

Definitive drawings are listed in numerical sequence by the Navy category code number assigned to that facility. Definitive drawings associated with this design manual can be used for guidance in acceptable design principles related to specific functional layouts and operation requirements. The architectural treatment, materials, framing, and construction may vary.

b. Other NAVFAC Design Manuals. For criteria related to maintenance facilities for ammunition, explosives, and toxics, but appearing elsewhere in the Design Manual series, see pages Reference-1 and Reference-2.

c. Planning Criteria. Planning criteria for maintenance facilities for ammunition, explosives, and toxics covered by this manual are contained in Facility Planning Factor Criteria for Navy and Marine Corps Shore Installations, NAVFAC P-80, Volume I, where each facility is listed in the numerical sequence by the Navy category code number assigned to that facility.

d. Other Criteria. Criteria contained in Volumes 1 and 2 of Ammunition and Explosives Ashore, NAVSEA OP 5 shall be a part of this manual as the criteria relate to the design of maintenance facilities.

4. GENERAL STRUCTURAL REQUIREMENTS. Structural design shall be in accordance with Structural Engineering, NAVFAC DM-2 Series; Seismic Design for Buildings, NAVFAC P-355; and Structures to Resist the Effects of Accidental Explosions, NAVFAC P-397.

5. ENERGY CONSERVATION. Energy conservation shall be a major consideration in the design of building envelopes, mechanical systems, and electrical systems for maintenance facilities for ammunition, explosives, and toxics. (See Heating, Ventilating, Air Conditioning and Dehumidifying Systems, NAVFAC DM-3.3 and Energy Budgets for New Facilities, NAVFAC INST 4101.1).

Each building envelope shall be insulated to provide the minimum heat transmission ("U") factors practical to meet Energy Budgets.

6. BUILDING PROTECTION. The building structure of all maintenance facilities, including corners, doors, structural members, etc., shall be protected from damage by vehicles and moving loads by the installation of concrete filled pipe guards, bumpers, railings, corner guards, and similar protective features.

7. LOADING DOCK RAMP PROTECTION. Each facility requiring a loading dock ramp shall be provided side edge protection in accordance with Section 1910.23c, Occupational Safety and Health Act Standards Manual.

8. FIRE PROTECTION. Fire protection for all maintenance facilities ammunition, explosives, and toxics shall be provided in accordance with requirements in Chapter 3, paragraph 3.2 of NAVSEA OP 5, Volume 1, and Fire Protection Engineering, NAVFAC DM-8.

9. SECURITY. Maintenance facilities for ammunition, explosives, and toxics shall be located so that physical security can be provided in accordance with United States Navy Physical Security Manual, OPNAVINST 5510.45.

10. SAFETY. To safeguard both personnel and neighboring structures, observe established separation and safety distances when locating structures. For data on minimum safety distances and separations, see NAVSEA OP 5, Volume 1. Designs of facilities shall meet all requirements of the Occupational Safety and Health Administration (OSHA) standards.

Section 2. GENERAL AMMUNITION MAINTENANCE SHOPS

1. FUNCTION. These buildings provide facilities and shops for maintenance of projectiles, fixed ammunition, rockets, fuses, primers, black powder cartridges and units, mortar ammunition, small-arms ammunition, pyrotechnic material, and inert material. Most Ammunition Rework and Overhaul Shops and most Rocket Rework and Overhaul Shops would be included in this grouping.

2. ARCHITECTURAL AND STRUCTURAL REQUIREMENTS.

a. Spaces. The following areas are normally required in general ammunition maintenance shops:

(1) Main Shop Area. This is usually an extensive area occupying the major portion of the building and sometimes divided into a series of work bays. Normally included in the main shop area are assembly-disassembly, leak testing, component testing, and repair operations.

(2) Office Space. Enclosed office space shall be provided for clerical tasks and record storage.

(3) Toilets. Toilet facilities shall be provided for male and female personnel.

(4) Cleaning Gear. Cleaning gear and janitorial storage shall be provided.

(5) Storage. Space shall be provided for storing and maintaining tools and equipment used in shop operations.

(6) Mechanical Equipment Room. An equipment room shall be provided to house mechanical equipment necessary to support building and shop functions.

(7) Paint Shop. An enclosed paint shop shall be provided in accordance with Spray Application Using Flammable and Combustible Materials, NFPA 33, when requirements for painting are a part of ammunition maintenance operations. A water wash spray paint booth should be considered depending on the type of painting operation required. Exterior lockers or an approved flammable liquid storage room shall be provided for paint storage. Space for a grit blast chamber shall be provided in facilities where major repainting is done on heavy thick walled containers such as projectiles. Locate dust collector and/or a baghouse for grit blast cleaning equipment outside the building.

b. Design. The building will normally be a single story structure and shall be constructed of noncombustible materials. Refer to Chapter 6, paragraph 6-3.1 of NAVSEA OP 5, Volume 1 and NAVFAC P-397 for general design and construction requirements for ammunition and explosive operating buildings. Loading/unloading docks shall be provided for rail cars and/or trucks as determined by the location of the facility. Standard construction, materials and finishes shall be in accordance with Architecture,

NAVFAC DM-1 and NAVFAC DM-2 Series. Special construction, materials, and finishes shall be as follows:

(1) Walls. Walls of main shop areas shall be reinforced concrete. Utilize barricades and blast walls to separate shop bays or work areas, when explosive hazards exist, depending on the nature of the operations involved.

(2) Floors. Floors shall be reinforced concrete. Conductive sparkproof floor finish shall be provided in areas where black powder or other high explosive is handled. Sparkproof floors shall conform to Guide Specification NFGS(TS)-09770, entitled "Metallic-Type Static Disseminating and Spark-Resistant Finish". Resilient floor finish shall be provided for office space only.

(3) Roof. Roofs should normally be reinforced concrete. Frangible roof sections shall be provided in explosive areas in accordance with NAVFAC P-397.

(4) Doors. Blastproof sliding doors shall be provided at both ends of main shop areas. Door openings shall be of adequate size to allow forklifts to move the largest anticipated containers in and out of the shop area. Blastproof personnel access doors with panic hardware shall be provided at both ends of shop areas.

3. MECHANICAL REQUIREMENTS. Mechanical requirements are as follows:

a. Heating and Air Conditioning. Heating and air conditioning, including humidity control, shall be provided for main shop areas as required by the type of ordnance being maintained and in accordance with NAVFAC DM-3.3. Where air conditioning is required for main shop areas, office spaces shall also be air conditioned. Heating only shall be provided for other spaces. Inside design temperatures, for controlled areas, shall be 75°F with a maximum relative humidity of 50 percent for cooling and 65°F for heating. Also, see Chapter 6, paragraphs 6-3.2.6 and 6-3.2.7 of NAVSEA OP 5, Volume 1 for general guidance.

b. Ventilation. Ventilation shall be provided in accordance with NAVFAC DM-3.3 and Chapter 6, paragraph 6-3.2.7 of NAVSEA OP 5, Volume 1. Specifically provide the following:

(1) Exhaust ventilation system with makeup air, heated as required, for the paint shop. The ventilation system shall be in accordance with NFPA 33.

(2) Makeup air, heated as required, for dust collector exhaust system if grit blast cleaning equipment is provided.

(3) Ventilation for battery shop, if battery charging equipment is supplied, as required by General Maintenance Facilities, NAVFAC DM-28.4, Section 5, Part 6.

c. Plumbing. Plumbing shall be provided in accordance with Mechanical Engineering, NAVFAC DM-3, Chapter 1. Specifically provide the following:

(1) Cold water supplies with hose-bibb outlets to main shop areas. Steam or hot water supplies to main shop areas that require washout operations. Cold water supply to the paint booth when one is supplied. Hose-bibb outlets shall be equipped with vacuum breakers.

(2) Floor drains in main shop areas and a drainage system for the paint booth when one is supplied. Connect drains to waste systems as required to prevent contamination of the normal storm drainage system. (See Chapter 6, paragraph 6-3.2.2 of NAVSEA OP 5, Volume 1 for requirements concerning drain lines handling explosive wastes.)

(3) Emergency showers and eyewashes when pyrotechnic and toxic chemical materials are handled in the facility.

d. Compressed Air. Compressed air at 100 psi shall be provided in accordance with NAVFAC DM-3, Chapter 7 for air hoist motors, painting equipment, tools, etc. Provide adequate outlets at work benches and other work areas. Compressed air supplies must be clean and dry and the system shall utilize adequate filters and dryers. Consider the requirements of the facility to determine if a separate air compressor should be provided rather than utilizing a central air supply. A separate air compressor would assure that an adequate quantity of compressed air is available. Separate air compressors may also provide lower operating and distribution costs. See Chapter 7 of NAVSEA OP 5, Volume 1 for authorized use of compressed air.

e. Noise and Vibration Control. All mechanical systems and equipment shall be designed to limit noise and vibration in accordance with NAVFAC DM-3, Chapter 15.

4. ELECTRICAL REQUIREMENTS. Electrical requirements, including power generation and distribution, lighting, grounding, and lightning protection shall be in accordance with Chapter 4 of NAVSEA OP 5, Volume 1; National Electrical Code, NFPA 70; Electrical Engineering, NAVFAC DM-4 Series and as follows:

a. Power.

(1) Single-phase, 120-volt, 20-ampere, 60-Hertz convenience outlets shall be provided in all spaces with spacing as required by NPFA 70.

(2) Equipment and wiring in the paint shop shall be in accordance with NFPA 33.

b. Lighting.

(1) Interior lighting shall normally be fluorescent.

(2) Exterior lighting shall be high pressure sodium vapor where practical.

(3) Design for lighting intensities shall be in accordance with the Department of Defense Construction Criteria Manual, DOD 4270.1-M.

(4) Fixtures and wiring in the paint shop shall be in accordance with NFPA 33.

c. Grounding and Lightning Protection.

(1) Primary and secondary systems shall be provided. (See Chapter 4 of NAVSEA OP 5, Volume 1.)

(2) Consider the use of cable reels for grounding conductors for ordnance equipment in shop areas. Cable reels must be located so that they do not interfere with overhead weight-handling equipment operations.

(3) Grounding in the paint shop shall be in accordance with NFPA 33.

5. WEIGHT-HANDLING EQUIPMENT. Monorail hoists and/or bridge cranes shall be provided in main shop areas, when the size of the ammunition units to be maintained are large enough to warrant weight-handling equipment. Mono-rail hoists and bridge cranes shall be of sparkproof construction with explosion-proof motors. Controls shall be operable from floor level and, when they are electric, shall be explosionproof. (See Chapter 1 of Weight-Handling Equipment and Service Craft, NAVFAC DM-38 for additional criteria).

Section 3. BOMB-TYPE AMMUNITION MAINTENANCE SHOPS

1. FUNCTION. These buildings provide facilities and shops for maintenance of Class 1 Division 1 ammunition such as bombs, mines, warheads, depth charges, and demolition material. Mine and Depth Charge Rework and Overhaul Shops, most Torpedo Shops and some Rocket Rework and Overhaul Shops would be included in this grouping.

2. ARCHITECTURAL AND STRUCTURAL REQUIREMENTS.

a. Spaces. Spaces will generally be required as described in Section 2, paragraph 2.a. In addition, the following spaces will usually be required:

(1) Instrument rack storage for mine rework facilities.

(2) Instrument test room for mine rework and torpedo rework facilities.

(3) Torpedo refueling room, where otto fuel is handled, for some torpedo rework facilities.

(4) Battery maintenance area for mine rework facilities.

b. Design. Design requirements described in Section 2, paragraph 2.b. are applicable to these facilities. In addition, the following design requirements shall be observed:

(1) The floor of areas where otto fuel is handled shall be sloped to a center grating covered sump. Coaming on all four sides of the otto fuel area shall be provided. The floor, sump, and coaming shall be concrete, steel troweled to a hard smooth surface and coated with three coats of epoxy paint conforming to the latest revision of Military Specification MIL-P-24441, Paint, Epoxy-Polyamide, General Specifications for. All other surfaces that may come in contact with the otto fuel shall be of a material compatible with the otto fuel or protected with multiple coats of epoxy paint. (See Otto Fuel II; Safety, Storage, and Handling, NAVSEA OP 3368).

(2) Battery charging equipment shall be provided for mine rework facilities in accordance with NAVFAC DM-28.4, Section 5, Part 6.

(3) An emergency shower and eyewash shall be provided for otto fuel handling areas and for battery charging facilities.

3. MECHANICAL REQUIREMENTS. Mechanical requirements are as follows:

a. Heating and Air Conditioning. Heating and air conditioning, including humidity control, shall be provided for instrument test rooms in accordance with NAVFAC DM-3.3. Heating and air conditioning shall be provided for main shop areas and the office. Humidity control shall be provided for instrument rack storage for mine rework facilities. Heating only shall be provided for other spaces. Inside design temperatures, for

controlled areas, shall be 75°F with a maximum relative humidity of 50 percent for cooling and 65°F for heating. Maximum relative humidity for the instrument test rooms and the instrument rack storage shall be as required for the instruments to be maintained and stored in this area. Also, see Chapter 6, paragraphs 6-3.2.6 and 6-3.2.7 of NAVSEA OP 5, Volume 1 for general guidance.

b. Ventilation. Ventilation requirements described in Section 2, paragraph 3.b. are applicable to these facilities. In addition, exhaust ventilation shall be provided with makeup air, heated as required, for torpedo refueling rooms. Ventilation should provide laminar air flow across primary work areas of the room, if possible. (See Chapter 6 of NAVSEA OP 3368).

c. Plumbing. Plumbing shall be provided in accordance with NAVFAC DM-3, Chapter 1. Specifically provide the following:

(1) Cold water supplies, with hose-bibb outlets, to otto fuel areas for flushing otto fuel spills and to main shop areas for normal floor maintenance. Cold water supply to the paint booth when one is supplied. Hose-bibb outlets shall be equipped with vacuum breakers.

(2) Exterior underground storage tank for otto fuel waste, with drainage piping from the sump in the torpedo refueling room. (See Chapter 6 of NAVSEA OP 3368 for material requirements).

(3) Floor drains in main shop areas and a drainage system for the paint booth when one is supplied. Connect drains to waste systems as required to prevent contamination of normal storm drainage systems. (See Chapter 6, paragraph 6-3.2.2 of NAVSEA OP 5, Volume 1 for requirements concerning drain lines handling explosive wastes).

d. Compressed Air. Compressed air shall be provided in accordance with NAVFAC DM-3, Chapter 7. Specifically provide the following:

(1) Low pressure compressed air as described in Section 2, paragraph 3.d.

(2) High pressure compressed air at 3000 psi to main shop areas of torpedo rework facilities. Dryers and filters shall be specified to assure an exceptionally clean and dry air supply.

e. Noise and Vibration Control. All mechanical systems and equipment shall be designed to limit noise and vibration in accordance with NAVFAC DM-3, Chapter 15.

4. ELECTRICAL REQUIREMENTS. Electrical requirements, including power generation and distribution, lighting, grounding, and lightning protection shall be in accordance with Chapter 4 of NAVSEA OP 5, Volume 1; NFPA 70; NAVFAC DM-4 Series; and as follows:

a. Power.

(1) Single-phase, 120-volt, 20-ampere, 60-Hertz convenience outlets shall be provided in all spaces with spacing as required by NFPA 70.

(2) Three-phase, 120/208-volt, 60-Hertz power outlets shall be provided in main shop areas and instrument test rooms of mine rework and torpedo rework facilities.

(3) Three-phase, 115/200-volt, 400-Hertz and 28-volt direct current power is required for main shop areas and the instrument test room of torpedo rework facilities. (See MIL-STD-704, Aircraft Electric Power Characteristics, for 400-Hertz and 28-volt direct current power requirements).

(4) The ampacity of 3-phase and direct current outlets shall be as required by the using agency for the specific facility.

(5) Equipment and wiring in the paint shop shall be in accordance with NFPA 33.

b. Lighting.

(1) Interior lighting shall normally be fluorescent.

(2) Exterior lighting shall be high pressure sodium vapor where practical.

(3) Design for lighting intensities shall be in accordance with DOD 4270.1-M.

(4) Fixtures and wiring in the paint shop shall be in accordance with NFPA 33.

c. Emergency Power. Emergency power for lighting and battery charging equipment shall be provided in mine rework facilities to protect batteries used in mine components during an extended power outage.

d. Grounding and Lightning Protection.

(1) Primary and secondary systems shall be provided. (See Chapter 4 of NAVSEA OP 5, Volume 1).

(2) Consider the use of cable reels for grounding conductors for ordnance equipment in main shop areas. Cable reels must be located so that they do not interfere with overhead weight-handling equipment operations.

(3) Grounding in the paint shop shall be in accordance with NFPA 33.

5. WEIGHT-HANDLING EQUIPMENT. A bridge crane, with capacity as required by the ordnance to be maintained, shall be provided in the assembly-disassembly area. Bridge cranes and/or monorail hoists in other areas shall be provided when the weight of components warrants weight-handling equipment. Bridge cranes and monorail hoists shall be of sparkproof construction with explosionproof motors. Controls shall be operable from floor level and, when they are electric, shall be explosionproof. (See Chapter 1 of NAVFAC DM-38 for additional criteria).

Section 4. PROPELLANT POWDER MAINTENANCE SHOPS

1. FUNCTION. These buildings provide facilities and shops for maintenance of bulk smokeless powder, bulk jet propulsion powder, bag charges, propelling charges, separate rocket motors, and propulsion units. Some Ammunition Rework and Overhaul Shops and some Rocket Rework and Overhaul Shops would be included in this grouping.

2. ARCHITECTURAL AND STRUCTURAL REQUIREMENTS.

a. Spaces. Spaces will generally be required as described in Section 2, paragraph 2.a.

b. Design. Design requirements described in Section 2, paragraph 2.b. are applicable to these facilities. Facilities where smokeless powder is handled shall be designed to prevent exposure of the powder to the direct rays of the sun.

3. MECHANICAL REQUIREMENTS. Mechanical requirements are as follows:

a. Heating and Air Conditioning. Requirements in Section 2, paragraph 3.a. are applicable to these facilities. Areas where smokeless powder is handled will require humidity control.

b. Ventilation. Requirements in Section 2, paragraphs 3.b., except subparagraph (3), are applicable to these facilities.

c. Plumbing. Plumbing shall be provided in accordance with NAVFAC DM-3, Chapter 1. Specifically provide the following:

(1) Cold water supply to the paint booth when one is supplied. To minimize the danger of a damp atmosphere, do not provide cold water supplies to areas handling smokeless powder.

(2) A drainage system for the paint booth when one is supplied. Connect the drain to a waste system as required to prevent contamination of the normal storm drainage system.

d. Compressed Air. Requirements in Section 2, paragraph 3.d are applicable to these facilities.

e. Noise and Vibration Control. All mechanical systems and equipment shall be designed to limit noise and vibration in accordance with NAVFAC DM-3, Chapter 15.

4. ELECTRICAL REQUIREMENTS. Electrical requirements, including power generation and distribution, lighting, grounding, and lightning protection shall be in accordance with Chapter 4 of NAVSEA OP 5, Volume 1; NFPA 70; and NAVFAC DM-4 Series. Electrical sources must be more than 10 feet from assembled rocket motors to prevent accidental ignition from induced currents (see Chapter 18 of NAVSEA OP 5, Volume 1). Requirements in Section 2, paragraph 4 are applicable to this facility.

Section 5. AIR/UNDERWATER WEAPONS SHOPS

1. FUNCTION. The air/underwater weapons (AUW) shop provides space and equipment for the storage, test, check, assembly, and limited maintenance of airborne torpedos and other airdrop weapons.

2. LOCATION. This facility shall be located so as to minimize the hazards of electromagnetic radiation. For guidance, see Design Principles and Practices for Controlling Hazards of Electromagnetic Radiation to Ordnance (HERO Design Guide), NAVSEA OD 30393. The facility shall also be located so that physical security can be provided in accordance with OPNAVINST 5510.45.

3. ARCHITECTURAL AND STRUCTURAL REQUIREMENTS.

a. Layout. Space allocations for this facility are given in NAVFAC P-80, Volume I. The arrangement and functional layout shall be as shown in NAVFAC P-272. Toilet facilities for male and female personnel shall be provided.

b. Design. Standard construction, materials, and finishes shall be in accordance with NAVFAC DM-1 and DM-2 Series. Special areas, construction, and finishes shall be as follows:

(1) Shops and Torpedo Storage. Interior and exterior walls of Shop No. 1, torpedo storage, and Shop No. 2 shall be 12-inch minimum reinforced concrete. Floors shall be concrete with a nonslip finish. Conductive flooring is not required. Other wall construction and floor finish shall be in accordance with NAVFAC DM-1. The roof system shall support a 2000-pound capacity monorail system in Shop No. 1 and Shop No. 2, and a 3000-pound capacity bridge crane in torpedo storage.

(2) Otto Fuel Ready Storage Room. This room shall be sized to handle and store ten 55-gallon drums of otto fuel. The floor of the room shall be 4-inches lower than normal building floor level and shall be sloped to a center grating covered floor sump. The floor shall be concrete, steel troweled to a hard smooth surface, and coated with three coats of epoxy paint conforming to Military Specification MIL-P-24441. All other surfaces that may come in contact with the otto fuel shall be of a material compatible with the otto fuel or protected with multiple coats of epoxy paint. (See NAVSEA OP 3368).

(3) Afterbody Shop. The requirements for this shop shall be as given in paragraph 3.b.(2), listed above, except the floor is at normal building level and there is no otto fuel storage. The floor sump shall be 24 inches wide, 48 inches long, and 18 inches deep. An emergency shower and eyewash shall be provided.

(4) Vaults. Vaults shall be provided as shown in NAVFAC P-272 and shall meet requirements in Chapter V Department of the Navy Information Security Program Regulation, OPNAVINST 5510.1.

(5) Garage. An emergency shower and eyewash shall be provided. Battery charging facilities shall be in accordance with requirement in NAVFAC DM-28.4, Section 5, Part 6.

(6) Paint Shop. The roof system shall support a 1000-pound capacity monorail system. The pair of bi-folding doors will require special closure and weatherstripping to seal around the monorail penetrations. A water spray paint booth should be considered for this shop. Paint storage shall be provided at the end of the vehicle storage shed. The paint shop shall be in accordance with NFPA 33.

(7) Shower and Change Rooms. Shower, eyewash, and change facilities shall be provided for personnel that work around otto fuel to meet the requirements for personnel hygiene in NAVSEA OP 3368.

(8) Coffee Mess. A kitchen unit with sink, hot and cold water, and heating equipment shall be provided in the coffee mess room.

(9) Exterior Pavement. Exterior pavement shall be in accordance with Civil Engineering, NAVFAC DM-5 Series.

4. MECHANICAL REQUIREMENTS. Mechanical requirements are as follows:

a. Heating and Air Conditioning. Heating, air conditioning, and humidity control shall be provided in accordance with NAVFAC DM-3.3 for all spaces except for the paint shop, mechanical equipment room, transformer and emergency generator room, afterbody shop, otto fuel ready storage room, and garage. These spaces shall be provided with heating only. Inside design conditions for the environmentally controlled spaces shall be 75°F with a maximum relative humidity of 50 percent for cooling and 65°F for heating.

b. Ventilation. Ventilation shall be provided in accordance with NAVFAC DM-3.3. Specifically provide the following:

(1) Exhaust ventilation with makeup air, heated as required, for the afterbody shop. Ventilation should provide laminar air flow across primary work areas of the room, if possible. (See Chapter 6 of NAVSEA OP 3368.)

(2) Exhaust ventilation system with makeup air, heated as required, for the paint shop. The ventilation system shall be in accordance with NFPA 33.

(3) Ventilation for battery charging equipment (see NAVFAC DM-28.4, Section 5, Part 6).

c. Plumbing. Plumbing shall be provided in accordance with NAVFAC DM-3, Chapter 1. Specifically provide the following:

(1) Piping for otto fuel from the otto fuel ready storage room to the otto fuel filling location in the afterbody shop. (See Chapter 6 of NAVSEA OP 3368 for valves, pipe, and fitting requirements.)

(2) An exterior underground storage tank for otto fuel waste, with drainage piping from the sumps in the otto fuel ready storage room and afterbody shop. (See Chapter 6 of NAVSEA OP 3368 for material requirements.)

(3) Cold water supplies, with hose bibb outlets, to otto fuel areas for flushing otto fuel spills and to Shop No. 1, Shop No. 2, torpedo storage, and garage for normal floor maintenance. Cold water supply to the paint booth when one is supplied. Hot and cold water to the kitchen unit in the coffee mess. Hose-bibb outlets shall be equipped with vacuum breakers.

(4) Floor drains in Shop No. 1, Shop No. 2, torpedo storage, and garage and a drainage system for the paint booth when one is supplied. Connect drains to industrial waste system as required to prevent contamination of normal storm drainage systems.

(5) An emergency eyewash and shower fixture in areas where the possibility of exposure to otto fuel exists.

d. Compressed Air. Compressed air shall be provided in accordance with NAVFAC DM-3, Chapter 7. Specifically provide the following:

(1) Low pressure compressed air as described in Section 2 paragraph 3.d.

(2) High pressure compressed air at 3000 psi to Shop No. 1 and Shop No. 2. Dryers and filters shall be specified to assure an exceptionally clean and dry air supply.

e. Noise and Vibration Control. All mechanical systems and equipment shall be designed to limit noise and vibration in accordance with NAVFAC DM-3, Chapter 15.

5. ELECTRICAL REQUIREMENTS. Electrical service, lighting, and communications shall be provided in accordance with NFPA 70, NAVFAC DM-4 Series, and as follows:

a. Power. The capacity of the shop as shown in NAVFAC P-272 should be verified for each design due to constantly changing electrical requirements.

(1) Single-phase, 120-volt, 20-ampere, 60-Hertz convenience outlets shall be provided in all spaces with spacing as required by NFPA 70.

(2) Three-phase, 120/208-volt, 60-Hertz; three-phase, 115/200-volt, 400-Hertz; and 28-volt direct current power shall be provided in Shop No. 1, Shop No. 2, and the instrument testing room. (See MIL-STD-704 for 400-Hertz and 28-volt direct current power requirements.)

(3) The ampacity of 3-phase and direct current outlets shall be as required by the using agency for the specific facility.

(4) Equipment and wiring in the paint shop shall be in accordance with NFPA 33.

b. Lighting. Lighting requirements of Section 2, paragraph 4.b are applicable to this facility.

c. Emergency Power. An emergency diesel electric generator shall be provided, with capacity as required by the using agency to meet the essential loads of the facility.

d. Shielding. An electromagnetic radiation survey shall be conducted to determine if shop spaces require shielding. Shielding for Shop No. 1 and Shop No. 2 shall be provided when a requirement is established by the survey. See Electromagnetic Radiation Hazards (Hazards to Ordnance), NAVSEA OP 3565, Volume II.

e. Grounding and Lightning Protection. Grounding requirements of Section 2, paragraph 4.c are applicable to this facility. Lightning protection shall be provided in accordance with NAVFAC DM-4.6 and as shown on NAVFAC P-272.

f. Communications. A two-way communication system shall be provided between the duty office and the guard house, shop areas, instrument testing, and garage.

6. SECURITY. Security features shall be provided in accordance with mandatory requirements which must be obtained from NAVFAC HQ. Selected light fixtures and the alarm control center shall be connected to the emergency diesel generator.

7. WEIGHT-HANDLING EQUIPMENT. The overhead bridge crane in the torpedo storage room shall have electric motorized bridge, trolley, and hoist with 3000-pound capacity. The monorail hoist in Shop No. 1 and Shop No. 2 shall have electric motorized trolley and hoist with 2000-pound capacity. The monorail hoist in the paint shop shall be a hand operated hoist and trolley with 1000-pound capacity. Electric bridge, trolley, and hoist motors shall be operated from floor level by pushbutton pendent controls and shall be capable of operating at slower speed for positioning loads and at higher speed for moving loads. (See Chapter 1 of NAVFAC DM-38 for additional criteria.)

Section 6. QUALITY EVALUATION LABORATORY

1. FUNCTION. Quality evaluation laboratories (QEL) provide the necessary facilities for performing analysis and tests to determine and maintain quality assurance of ammunition, explosives, and toxics.

2. LOCATION. These facilities shall be located to meet the requirements of minimum separation and safety distances for the materials to be handled in the QEL in accordance with criteria in Volumes 1 and 2 of NAVSEA OP 5.

3. LAYOUT. The layout of this facility normally provides the four major areas listed. These major areas should be situated in individual wings which contain spaces having similar functions.

a. Office Wing. This area includes offices, a technical library, a vault, conference rooms, and male and female toilet facilities.

b. Chemical Testing Wing. This area includes a chemical laboratory, boiler room, machine shop, photo laboratory, spectrophoto chemistry area, and male and female toilet and locker facilities.

c. Test Cell Wing. This area includes test cells for various testing purposes, magazines for storage, and a general work area.

d. Mechanical and Electronics Wing. This area consists of a mechanical laboratory, electronics laboratory, maintenance and calibration rooms, endurance test room, proximity fuse test room, and an X-ray room.

4. ARCHITECTURAL AND STRUCTURAL REQUIREMENTS. Construction, materials and finishes shall be in accordance with NAVFAC DM-1; DM-2 Series; NAVSEA OP 5, Volume 1, Chapters 6 and 25; and as follows:

a. Walls and Partitions. Walls and partitions shall be reinforced concrete, designed for blast resistance, for storage magazines, test cells, and other areas where explosion hazards exist. Walls for other areas shall be of noncombustible materials.

b. Roofs. Explosive areas shall have frangible roof sections in accordance with NAVFAC P-397. Other roofs should be reinforced concrete.

c. Floors. Floors shall be concrete slab on grade. Floors shall be finished as follows:

(1) Provide suitable resilient floor finish for offices, library, conference rooms, and laboratories that do not require conductive floors (see Chapter 4, paragraph 4-7.2.4.b of NAVSEA OP 5, Volume 1).

(2) Provide ceramic tile in toilet and locker room facilities.

(3) Provide conductive concrete or similar conductive flooring material for test cells, magazines, loading platforms, and any work area where conductive floors are required by paragraph 4-7.2.4.b of NAVSEA OP 5,

Volume 1. Conductive flooring material shall be in accordance with NAVFAC Guide Specification NFGS(TS)-09770.

d. Retaining Walls and Barricades. Concrete retaining walls and earth barricades shall be provided around test cell wing to reduce explosion hazards to personnel and nearby structures.

5. MECHANICAL REQUIREMENTS. Mechanical requirements are as follows:

a. Heating and Air Conditioning. Heating and air conditioning shall be provided in accordance with NAVFAC DM-3.3.

b. Ventilation. Ventilation shall be provided in accordance with NAVFAC DM-3.3. Photo and X-ray laboratories and printing and developing rooms shall be provided with filtered supply air. Filtered makeup air shall be provided for exhaust systems and fume hoods.

c. Plumbing. Plumbing shall be provided in accordance with NAVFAC DM-3, Chapter 1.

d. Compressed Air. Compressed air at 100 psi shall be provided to laboratories and general work areas in accordance with NAVFAC DM-3, Chapter 7.

e. Noise and Vibration Control. All mechanical systems and equipment shall be designed to limit noise and vibration in accordance with NAVFAC DM-3, Chapter 15.

6. ELECTRICAL REQUIREMENTS. Electrical requirements, including power generation and distribution, lighting, grounding, and lightning protection shall be in accordance with Chapter 4 of NAVSEA OP 5, Volume 1; NFPA 70; NAVFAC DM-4 Series; and as follows:

a. Shielding. Proximity fuse test rooms shall be shielded to prevent interference with electronic testing operations. For shielding requirements, see NAVSEA OP 3565, Volume II.

b. Power.

(1) Single-phase, 120-volt, 20-ampere, 60-Hertz convenience outlets shall be provided in all spaces with spacing as required by NFPA 70.

(2) Three-phase, 120/208-volt and 480-volt, 60-Hertz; three-phase, 115/200-volt, 400-Hertz; and 28-volt direct current power shall be provided in laboratories and shops as required by the using agency.

c. Lighting.

(1) Interior lighting shall normally be fluorescent.

(2) Exterior lighting shall be high pressure sodium vapor where practical.

(3) Design for lighting intensities shall be in accordance with DOD 4270.1-M.

(4) Photo and X-ray laboratories and printing and developing rooms shall be provided with a means to prevent inadvertent activation of the lighting in the rooms.

Appendix A

METRIC EQUIVALENTS

METRIC EQUIVALENT CHART

The following metric equivalents are approximate and were developed in accordance with ASTM E 621.

English (ft)	Metric (mm)
10	3000

English (in)	Metric (mm)
48	1200
24	600
18	450
12	300
4	100

English (gallons)	Metric (L)
55	208

English (lbs)	Metric (kg)
3000	1500
2000	1000
1000	500

English (psi)	Metric (kPa)
3000	20 684
100	700

English (°F)	Metric (°C)
75	24
65	18

REFERENCES

DOD Publications

DOD 4270.1-M	Department of Defense Construction Criteria Manual

DOD publications may be obtained from the Department of Defense, The Pentagon, Washington, DC 20301.

Military Standards (MIL-STD) and Specifications (MIL)

MIL-STD-704	Aircraft Electric Power Characteristics.
MIL-P-24441	Paint, Epoxy Polyamide, General Specifications for

Military standards and specifications may be obtained from the U.S. Naval Publications and Forms Center, 5801 Tabor Ave., Philadelphia, PA 19120. TWX: 710-670-1685, AUTOVON: 442-3321.

National Fire Protection Association

NFPA 33	Spray Application Using Flammable and Combustible Materials.
NFPA 70	National Electrical Code.

NFPA standards are available from the National Fire Protection Association, Boston, MA 02110.

NAVFACENGCOM Design Criteria

DM-1	Architecture
DM-2 Series	Structural Engineering
DM-3 Series	Mechanical Engineering
DM-4 Series	Electrical Engineering
DM-5 Series	Civil Engineering
DM-7	Soil Mechanics, Foundations, and Earth Structures
DM-8	Fire Protection Engineering
DM-9	Cold Regions Engineering

DM-28.4	General Maintenance Facilities.
DM-38	Weight-Handling Equipment and Service Craft.
INST 4101.1	Energy Budgets for New Facilities
P-80, Volume I	Facility Planning Factor Criteria for Navy and Marine Corps Shore Installations
P-272	Definitive Designs for Naval Shore Facilities
P-355	Seismic Designs for Buildings
P-397	Structures to Resist the Effects of Accidental Explosions

Government agencies may obtain Design Manuals, Instructions, and P-Publications from the U. S. Naval Publications and Forms Center, 5801 Tabor Ave., Philadelphia, PA 19120. TWX: 710-670-1685, AUTOVON: 442-3321. The stock number is necessary for ordering these documents and should be requested from the NAVFACENGCOM Engineering Field Division in your area.

NON-Government organizations may obtain Design Manuals, Instructions, and P-Publications from the Superintendent of Documents, U. S. Government Printing Office, Washington, DC 20402.

NAVFACENGCOM Guide Specifications

NFGS(TS)-09770	Metallic-Type Static Disseminating and Spark-Resistant Finish

NAVFAC guide specifications are available, free of charge, from the U. S. Naval Publications and Forms Center, 5801 Tabor Ave., Philadelphia, PA. 19120 TWX: 710-670-1685, AUTOVON: 442-3321.

NAVSEA Publications

NAVSEA OP 5	Ammunition and Explosives Ashore
NAVSEA OP 3368	Otto Fuel II; Safety, Storage, and Handling
NAVSEA OP 3565, Volume II	Electromagnetic Radiation Hazards (Hazards to Ordnance)
Part One	(Hazards to Unclassified Ordnance Systems)
Part Two	(Hazards to Classified Ordnance Systems)

NAVSEA OD 30393 — Design Principles and Practices for Controlling Hazards of Electromagnetic Radiation to Ordinance (HERO Design Guide)

Government agencies may obtain NAVSEA Publications from the U. S. Naval Publications and Forms Center, 5801 Tabor Ave., Philadelphia, PA 19120. TWX: 710-670-1685, AUTOVON: 442-3321. The stock number is necessary for ordering these documents and should be requested from the NAVFACENGCOM Engineering Field Division in your area.

Occupational Safety and Health Act Standards Manual, Department of Labor, Occupational Safety and Health Administration (OSHA), Washington, DC 20210.

OPNAV Instructions

INST 5510.1 — Department of the Navy Information Security Program Regulation

INST 5510.45 — United States Navy Physical Security Manual

Government agencies may obtain OPNAV Instructions from the U. S. Naval Publications and Forms Center, 5801 Tabor Ave., Philadelphia, PA 19120. TWX: 710-670-1685, AUTOVON: 442-3321. The stock number is necessary for ordering these documents and should be requested from the NAVFACENGCOM Engineering Field Division in your area.

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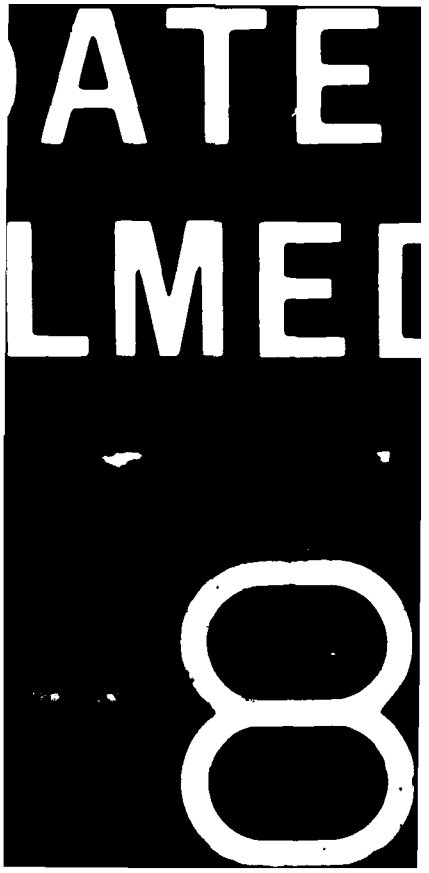
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